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# V.

## *On the Secular Periodicity of the Aurora Borealis.*

By JOSEPH LOVERING,

HOLLIS PROFESSOR OF MATHEMATICS AND NATURAL PHILOSOPHY IN HARVARD COLLEGE.

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It is said in Holmes's *Annals of America*,\* that the aurora was first seen in New England on December 17, 1719. The historian refers to Dr. Trumbull's Century-Sermon, preached at New Haven, on January 1, 1801, in which occurs the following note : † — "The aurora borealis, or northern light, is a new appearance in the heavens to this country, peculiar to the eighteenth century. It had been seen in Great Britain, especially in the north of Scotland, for many centuries past; but even in that country it had not appeared for eighty or one hundred years, until March 6, ‡ 1716. Its first appearance in New England was on the 17th of December, 1719. It appears to have been a great light, and began about eight o'clock in the evening. It filled the country with the greatest alarm imaginable. It was the general opinion, that it was the sign of the coming of the Son of Man in the heavens, and that the judgment of the great day was about to commence. According to the accounts given by the ancient people who were spectators of it, there was little sleep in New England that night." An anonymous account of this aurora by an eyewitness, dated December 15, 1719, has been republished in the Collections of the Massachusetts Historical Society.§ The author remarks in the first paragraph: "And I hope (though I believe I shall differ from some) I shall say nothing that shall be inconsistent either with Divinity or Philosophy." This aurora was seen from eight o'clock in the evening until an hour or two before daybreak the next morning. Its appearance at eleven o'clock "was somewhat dreadful,—sometimes it looked of a flame, sometimes a blood-red color,—and the whole northeast horizon was very light, and looked as though the moon had been near her rising." The description ends in these words: "Thus I have given you the best account I am able of this meteor, which, though very unusual here, [is] yet in

\* Vol. I. p. 523.

† Page 5.

‡ Old Style.

§ Vol. II. pp. 17–20.

Northern countries more frequent, and seems to me to be what our modern philosophers call *Aurora Borealis*."

I suggest, in this connection, whether the following extracts from Winthrop's History of New England\* do not indicate the appearance of an aurora in New England at a much earlier date than that ascribed to it by Dr. Holmes and others. "About midnight three men, coming in a boat to Boston, saw two lights arise out of the water, near the north point of the town cove, in form like a man, and went at a small distance to the town, and to the south point, and there vanished away." "The like was seen by many a week after." In the description of the second case, it is added: "A light like the moon arose about the northeast point in Boston, and met the former at Nottle's Island, and there they closed in one, and then parted and closed and parted divers times, and so went over the hill in the island and vanished. Sometimes they shot out flames and sometimes sparkles." These luminous appearances occurred on the 11th and 18th of April, 1643.

Many of this generation, accustomed as they have been to frequent displays of the aurora, will read with surprise the statement that the aurora was observed for the first time in New England in 1719, with the possible exceptions just quoted from Winthrop's journal. For the inference is, that no aurora, or at least no conspicuous exhibition of it, had occurred here before, since the settlement of the country. The people of New England were too much inclined to exaggerate every unusual phenomenon in the heavens to have overlooked or been silent in regard to a spectacle so strange as the aurora, had they had the opportunity of beholding one. That the aurora had been equally uncommon in Old England during the century previous to 1719, appears from the fact that the great astronomer, Dr. Halley, was, as he says, dying to see one, and that he expected to die without seeing it. At last the opportunity came, on March 17, 1716, when Halley was sixty years old. In his description of it, he says:† "This was the only one I had as yet seen, and of which I began to despair, since it is certain it hath not happened to any remarkable degree in this part of England since I was born." He adds that the like is not recorded in the English annals since 1574, or for one hundred and forty years. It was then seen on two successive nights, November 25 and 26. It was also seen at London on February 10, 1560, and on October 18, 1564. Notwithstanding this infrequency of the aurora in England for a long period *prior* to 1716, John Huxham observed it at Plymouth, England, in eighty-one instances between 1728 and 1748.‡ The Philosophical Trans-

\* Vol. II. pp. 152, 153.

† Phil. Trans., XXIX. 416.

‡ Amer. Journ. of Sci., XXXIII. 297.

actions of London make no mention of auroras before 1716, though they had been published for forty years ; but they record two hundred observations, made in different places, between 1716 and 1750.\* The Academy of Sciences, founded at Paris in 1666, is silent upon the subject for fifty years after its establishment.

E. J. Burman writes under the date of October 30, 1722, that the aurora had been seen at Upsal thirty times during the last five months. Celsius states it had been rarely seen in Sweden before 1716, and yet between 1716 and 1732 there may be found three hundred and sixteen observations on two hundred and twenty-four independent recurrences of the phenomenon. He heard from the old men then living at Upsal, that these northern lights were novel even to them in that high latitude, and he concludes, from all the evidence he could collect, that these phenomena were periodical near the arctic circle as well as on the parallels of Europe. "It is impossible to believe," says Celsius, "that the skilful observers of the last century, who passed their lives in the Observatories erected for them, particularly at Paris and Greenwich, should not have taken care to transmit to posterity their observations on this admirable phenomenon, if it had appeared in their time." Mairan adduces also the authority of Anderson, found in his Natural History of Iceland. "It has always appeared extraordinary to me," he says, "that the most ancient Icelanders, as they have assured me, should have been astonished themselves at the frequent appearance of the aurora in their island, declaring that formerly they were much less common than to-day." . . . "But I am so much the more ready to believe them, as it is certain that in other countries of Europe this phenomenon was much more uncommon formerly than now." The first recorded appearance of an aurora in Italy belongs to the year 1727.† Zanotti and Beccari have collected fifty-two exhibitions of it in Bologna and other parts of Italy, between the years 1727 and 1751, and thirty-six doubtful cases. Zanotti, in his description of the aurora which was seen in Italy, as well as in England, on December 16, 1737, says: "The Aurora Borealis, which was formerly a rare phenomenon, and almost unknown in this our climate (Italy), is now become very frequent. A great number have been observed for some years past."‡ The language of Halley, Leibnitz, Kirch, Fontenelle, and Miraldi, in describing the auroras of the first half of the eighteenth century as *uncommon sights*, and the silence of Cassini in respect to any such display in the latter half of the preceding century, point to one and the same explanation.

The periodicity in the occurrence of the aurora, which seems to be roughly fore-

\* Bertholon in Encyc. Method.

† Musschenbroek, Nat. Phil., 1314.

‡ Phil. Trans., XLI. 593.

shadowed in what has already been said, was illustrated and confirmed by the comprehensive review of the subject which Mairan made in his *Traité Physique et Historique de l'Aurore Boréale*, published by the French Academy first in 1731, and a second edition in 1754. Mairan was incited to his great labor by the remarkable aurora of October 19, 1726. The first edition contained the record of 229 auroras, scattered over the long interval between the years 500 and 1731. These appearances were divided into 22 distinct groups, separated from each other by unequal intervals of time, themselves barren in auroral displays. But in the *Eclaircissemens* of the second edition of his work, Mairan had accumulated 2137 recorded observations, or, subtracting the duplicates, 1441 independent exhibitions of the aurora between the years 583 and 1751. With this large accession of new materials, Mairan would doubtless have modified the number and epoch of his groups, had he pursued the subject further in that direction. If the whole interval between 541 and 1751 is divided into seven periods of thirty years each, there are, according to Mairan's catalogue, 38 appearances of the aurora in the first period, or between 541 and 571; 66 appearances in the second period, or between 571 and 601; 57 appearances in the third period, or between 601 and 631; 18 appearances in the fourth period, or between 631 and 661; 26 appearances in the fifth period, or between 661 and 691; 195 appearances in the sixth period, or between 691 and 721; and 908 in the seventh period, or between 721 and 1751. In the year 1732, one hundred auroras were observed; and in 1730, one hundred and sixteen. The general progress of physical science and the multiplication of observers may *partly* account for the large numbers in the sixth and seventh cycles; but they fail to explain the inferiority of the fourth and fifth cycles to the second and third. Hansteen\* distinguishes twenty-four periods between 502 B. C. and the present epoch, particularly the ninth, which is from 541 to 603; the twelfth, which is from 823 to 887; the twenty-second, which is from 1517 to 1588; and the twenty-fourth, which is from 1707 to 1788. He assigns the maximum of the latter period to 1752; but it is much nearer a minimum, as I shall show hereafter.

The weight of evidence which Mairan has accumulated in favor of the periodicity of the aurora has not been universally held conclusive. Bertholon† has argued against what he calls the *pretended* interruptions in the occurrence of this phenomenon. He maintains that there really exists no cessation in the auroral displays, and explains away the apparent cessation by accidental circumstances, as the lack of observatories, the scarcity of observers, their want of experience, their bad geographical position, or their inability

\* Pogg. Ann., XXII. 536, 537. Kaemtz's Meteorology, p. 458.

† Encyc. Method. Phys., I. 347 - 349.

to communicate with the public by printed books, or through the transactions of academies. And he quotes from Fontenelle a remark to the effect that a man does not often see more than he already knows to exist. Considerations like these are, no doubt, entitled to great weight in comparing together the number of auroras observed in *ancient* and *modern* times. They account in part for the increasing number of observed auroras as we approach the present epoch; but they fail to explain the alternate increase and decrease in the number of auroras from one quarter of a century to another, and especially will they fail if it is found that the same fluctuations which are indicated by Mairan's historical investigations are repeated during the last century, and even under our own eyes.

I shall next consider how the observations of the last one hundred years affect this question of the periodicity of the aurora. In 1754, Mairan \* commented on the fact that the aurora had begun again to diminish in frequency in France, so that he found no instance between November 3, 1740, and February 3, 1750, which would answer the purpose of determining the height of an aurora by its parallax. The St. Petersburg observations declare that Mairan was correct in his forebodings. They furnish two hundred and sixteen auroras between 1729 and 1743 inclusive, and only forty-six between 1744 and 1758 inclusive, there being thirty-five in one year, 1730, and none in 1753 and 1754. Dalton † has published two hundred and twenty-seven appearances of the aurora in Kendal and Keswick, between the years 1787 and 1793, of which twenty-nine were observed at both places, and all but ten at Kendal. In Dalton's catalogue of auroras, observed in Great Britain and Ireland between the years 1793 and 1834, fifty-five occurred before 1810, and only seventeen between 1810 and 1826 inclusive, though the latter period is longer by one year. Then, again, one hundred and thirteen auroras were observed in the last eight years of Dalton's observations, between 1827 and 1834 inclusive. In this latter period eight are designated as *grand*, and many others as *fine*. Thirty-two auroras were seen in one year, 1830. But there were none in 1807, 1809, 1810, 1811, 1812, 1813, 1815, 1822, 1823, and 1824. No wonder that Singer remarks in his *Elements of Electricity*, ‡ published in 1814, that the aurora was then rarely visible in England. Arago § stated in September, 1827, that no aurora had been seen before in Paris for twenty years. Böckmann || observed at Carlsruhe twenty-three auroras in 1779, seventeen in 1780, fifteen in 1781, eight in 1782, ten in 1783, one in 1789, and no more for the next 12 years.

It may be interesting to inquire how the case stands in the western hemisphere, and

\* Page 430.

† Meteor. Observ. and Essays, p. 54.

‡ Page 253.

§ Amer. Journ. Sci., XIV. 107.

|| Gilbert Ann., VII. 32.

whether it sustains the European history of the aurora for the last three centuries. I have mentioned the surprise excited in New England by the aurora of 1719. After such a commencement, there are scattered accounts of the aurora during the remainder of the century. Mr. Greenwood; then Hollis Professor of Mathematics and Natural Philosophy in Harvard College, described an aurora seen at Cambridge on November 2, 1730. His successor, Professor John Winthrop,\* has recorded nine exhibitions of it between 1741 and 1757. Mr. Caleb Gannett † mentions an aurora, accompanied by an east and west arch, which was seen at Cambridge on March 27, 1781. Manasseh Cutler noticed the aurora repeatedly at Ipswich in 1781.‡ Auroras were seen at Salem on November 17 and 24, 1720, on January 1 and October 2, 1728, and an extraordinary one on October 22, 1730. On December 29, 1736 (probably), Dr. Holyoke witnessed an aurora of which he says: "The first aurora borealis I ever saw. The northern sky appeared suffused by a dark blood-red colored vapor, without any variety of different colored rays. I have never seen the like. Northern lights were then a great novelty, and excited great wonder and terror." On August 6, 1768, a bright streak of light extended from the west northwest to the southeast, almost as bright as a rainbow. On July 19, 1769, there was an aurora of unusual brightness.§ On April 21, 1750, the aurora was seen as far south as Charleston, S. C. One who beheld it has given the following description:—"We had a most extraordinary appearance of the aurora borealis. One half of the sky seemed like a beautiful streaked liquid flame, so terrible to many of the female inhabitants that some of them were thrown into fits." || Auroras were observed at Cambridge by Professor Williams, in co-operation with the Meteorological Society of the Palatinate, during its brief period of activity. Professor C. Dewey, then of Williams College, observed auroras on May 23 and 28, 1818; also from June 6 to June 10, on September 24 and 25, and on October 6 and 7 of the same year.

It is well known to many members of this Academy, that Dr. Holyoke, of Salem, kept a Meteorological Journal from 1754 to 1828. That part which relates to the weather has already been published in the Memoirs of the Academy. I have consulted the manuscript records of Dr. Holyoke, which he presented to the Academy, and have selected from them all the auroras he has observed and recorded. Unfortunately, the copy in possession of the Academy is not the original, until the year 1786; and, being prepared for a special purpose, it does not contain any notice of auroras, if, indeed, any were observed before 1786. But the Academy also possesses the original manuscript

\* Amer. Journ. Sci., XL. 204.

† Mem. Amer. Acad., II. 136.

‡ Mem. Amer. Acad., I. 366.

§ Felt's History of Salem, II. 137.

|| Gent. Mag., XX. 418, and XXI. 39.

Journal of Meteorology kept at Cambridge by Professor John Winthrop, from 1742 to 1779; that of Professor Edward Wigglesworth, kept also at Cambridge from 1782 to 1793; and that of Dr. Enoch Hale, kept at Boston, from 1818 to 1848. In all these journals, except the last, the auroras are noted with great care. Dr. Hale, probably, recorded only the most conspicuous. This collection of manuscripts covers more than a century of time, in which only two years are unrepresented, namely, 1780 and 1781. From this rich storehouse of observations, I have been able to cull 624 recorded examples of auroras, of which only 79 are duplicates. After subtracting these, 545 independent auroras remain, which have never before appeared in print. Of the 624 observations contained in all the manuscripts, 254 were registered by Professor Winthrop, 136 by Professor Wigglesworth, 198 by Dr. Holyoke, and the balance (36) by Dr. Hale. As all these observations have been made at places only a few miles apart,\* they are strictly comparable with each other, and furnish an almost uninterrupted history of the aurora in this immediate vicinity for a century. It appears from these journals, that during the thirty-three years, between 1792 and 1826 inclusive, only 48 auroras were observed; but that during the thirty-three years *next preceding* 1792, there are registered 387 independent auroras. And even during the eighteen years between 1742 and 1759 inclusive (or as far back before 1759 as the observations extend), 77 auroras are recorded. And single years may be selected in which there occurred nearly twice as many auroras as in the whole period of thirty-three years, ending with 1826. None were observed in the years 1796, 1797, 1798, 1799, 1800, 1801, 1807, 1808, 1810, 1811, 1812, 1813, 1816, and 1817. Observations on the aurora, made exclusively in the State of New York,† between the years 1826 and 1850 inclusive, exhibit 1152 independent appearances during that period of twenty-five years; and, when combined with those already described, they manifest for this part of the United States what Dalton's observations have demonstrated for England and Ireland, namely, that the displays of the aurora are in a high degree intermittent.

A study of the sequences in the succession of remarkable auroras may be even more instructive than an indiscriminate attention to all; for this reason, if for no other, that such auroras can hardly have escaped detection and description in early times. In the United States, great auroras were witnessed on December 17, 1719; on October 22

\* Winthrop's Journal was kept at Andover during May, June, July, and August, at Watertown during September, October, and November, 1775; and at Concord, from December, 1775, to June 18, 1776; Cambridge being the head-quarters of the Revolutionary army.

† Results of a Series of Meteorological Observations, made in Obedience to Instructions from the Regents of the University at sundry Academies in the State of New York, from 1826 to 1850, inclusive, and compiled from the original Records and the Annual Reports of the Regents by Franklin B. Hough, M. D., p. 472.



and November 2, 1730; on December 29, 1736; on April 21, 1750; on August 6, 1768; and on July 19, 1769; descriptions of which have already been published. I have selected from the unpublished manuscripts already mentioned all those examples of auroras which are described as *red*, or *bright*, or *high*, or *great*, or *considerable*, or *brilliant*, or *unusual*, or *remarkable*. In the catalogue which follows, the *most* extraordinary exhibitions are printed in *italics*.

1743. January 12.	1772. <i>July 8.</i>
1746. March 1, June 1.	1773. <i>January 17, January 19, July 12, July 17.</i>
1747. <i>August 19.</i>	1774. March 13, August 14.
1749. October 7.*	1777. April 6, <i>September 7, November 3, November 27.†</i>
1750. <i>February 16, April 3, October 22.</i>	1778. February 17, March 24, April 23, <i>September 24.</i>
1752. January 8.	1779. February 10.
1757. <i>November 12.</i>	1786. February 28, March 13, March 19, <i>October 17.</i>
1758. January 8, <i>March 31.</i>	1787. June 8, July 13, July 14, October 13, <i>November 3,* November 24.*</i>
1759. <i>September 31.</i>	1788. <i>July 30.*</i>
1760. May 3.	1789. March 14, May 23, August 18, <i>November 14.</i>
1761. November 19.	1818. <i>March 24.</i>
1762. May 21, August 10, December 18.	1827. <i>August 28, September 8.</i>
1763. July 31, September 14, November 11.	1830. December 11.
1764. <i>March 5, June 18.</i>	1838. <i>February 21, November 12.</i>
1765. July 22, August 19.	1839. <i>January 14, January 19.</i>
1768. <i>July 20, December 5.</i>	1840. <i>August 28.</i>
1769. January 5, February 27, June 9, July 2, <i>October 7.</i>	1848. <i>April 6.</i>
1770. January 18,* <i>March 23,† April 19, August 27.</i>	
1771. <i>March 17, June 2.</i>	

The examination of this list of unusual auroras betrays a very partial chronological distribution. During the larger part of the 18th century, down to 1789, they were frequent, there being in all 76 examples, of which 30 are marked as particularly conspicuous. Between the years 1789 and 1826, a solitary instance is found, on March 24, 1818. From 1827 to 1848, I depend on Dr. Hale's record, which is evidently less complete in this specialty than the others. But I find even there 8 unusual auroras mentioned, of which 5 are worthy of *italics*. For more ample information in regard to remarkable displays of auroras since 1827, the catalogue of New York auroras, already quoted, may be consulted to advantage. Professor Olmsted has selected from the catalogues of Dalton and the Regents of the State of New York 12 auroras between 1827 and 1848 inclusive, which he assigns to the first rank of auroras, as he has classified them.† I annex a list of those which Dr. Hough has characterized as

\* Red.

† Very extraordinary.

‡ Smithsonian Contributions to Knowledge, VIII.

brilliant, the *very* brilliant specimens being printed *in italics*, and a few of a highly extraordinary character being signalized by an asterisk. Of brilliant auroras, 157 are registered: of these 81 are designated as very brilliant, and 4 as highly extraordinary.

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| <p>1827. <i>August 28.*</i></p> <p>1828. August 16, September 8, <i>September 29</i>, October 8.</p> <p>1829. <i>June 1</i>, June 7, September 26, November 9, December 28.</p> <p>1830. <i>March 15, April 19</i>, May 2, <i>June 10, June 11, July 14, July 15, August 19</i>, August 20, <i>September 15, October 28, December 7, December 10, December 11.</i></p> <p>1831. January 7, <i>February 6, March 8</i>, March 18, <i>April 1, April 18, April 19,* April 20</i>, June 10, <i>June 21, July 3, July 4</i>, October 29, December 9.</p> <p>1832. <i>August 22, August 23, August 24.</i></p> <p>1833. <i>March 17, May 16, May 17</i>, June 29, <i>July 10, September 5, November 3, December 29.</i></p> <p>1834. <i>October 8, November 2.</i></p> <p>1835. <i>January 4</i>, August 19, September 4, September 22, <i>November 17, November 18.</i></p> <p>1836. April 19, <i>April 22, April 23, May 8, May 19, July 31, August 2, August 12.</i></p> <p>1837. <i>January 14</i>, April 6, <i>July 1, October 22</i>, November 12, <i>November 14.</i></p> <p>1838. February 20, February 21, July 27, August 22, <i>September 14, September 15, September 16, November 9, November 26.</i></p> | <p>1839. January 10, <i>January 14</i>, March 5, May 5, June 7, August 28, <i>September 3,*</i> October 10.</p> <p>1840. <i>January 3, May 29.</i></p> <p>1841. <i>February 23, March 23, June 15, July 29, August 4, August 6, September 25</i>, October 5, <i>November 18.</i></p> <p>1842. <i>April 14</i>, June 4, July 3, <i>August 5.</i></p> <p>1843. March 7, <i>April 15, June 3, June 22</i>, August 3, <i>October 5.</i></p> <p>1844. <i>February 4, October 20</i>, November 1, <i>December 15.</i></p> <p>1845. <i>January 8, January 9, February 25, April 13, November 3, December 3.</i></p> <p>1846. March 25, May 30, <i>August 6, September 23, October 2, December 9.</i></p> <p>1847. January 17, <i>February 21, March 19</i>, April 6, <i>April 7, August 4, August 29, October 24, November 1, November 25, December 7.</i></p> <p>1848. January 6, <i>January 16, February 8</i>, February 18, <i>February 21, March 23, April 1, April 5, April 6, July 3, July 11, July 12, July 23, August 14, August 21, October 23, November 17,*</i> November 18, November 26, December 27.</p> <p>1849. July 24.</p> |
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Dr. Holyoke's Journal furnishes *positive* testimony in favor of a conclusion which had been adopted already from *negative* evidence; from the absence, that is, of any description of a remarkable aurora seen in this country during the present century *before* 1827, although the Memoirs of the American Academy of Arts and Sciences in Boston, the Transactions of the Philosophical Society of Philadelphia, and, after 1818, the American Journal of Science were in existence, and would have furnished a convenient medium for the publication of any aurora which deserved the attention of the scientific world. Therefore, as Professor Olmsted remarks, "the splendid arch and other striking accompaniments of the aurora of August, 1827, took us by surprise, and were viewed with wonder by nearly all the existing generation of the countries where it was visible." † Mr. Felt says that it caused much apprehension lest the end of all

\* Red.

† Smithsonian Contributions, VIII. 6.

things had come. The arch which signalized this aurora had been seen by Dr. Holyoke, who was then ninety-nine years old, only twice before, viz. in 1755 and 1769. The sight of a magnificent aurora was so unusual, that in August, 1827, the bells were rung in Salem to call attention to it.

Accordingly, the discussion of American observations, both of ordinary and extraordinary auroras, substantiates the general conclusion first suggested by European observation; namely, that there is a *secular periodicity* to the phenomenon, twenty years or more of abundant exhibitions being separated by intervals, equally long or longer, when these displays, if not wholly wanting, are stripped of their more brilliant characteristics. Moreover, these repeated interruptions in the return of auroras are such as no failure of memory, no negligence of observers, and no deficiencies of history can adequately explain.

Another decline in the frequency and brilliancy of the aurora since 1850 is manifest. This will appear from an examination of the Regent's Reports, made since the publication of Mr. Hough's Results &c. It will also appear, by consulting the American Journal of Science, which contains probably a notice of all the conspicuous auroras in recent years. On September 29, 1851, an aurora was visible in the Southern States. On February 19, 1852, a grand aurora was seen in New Hampshire and Vermont. Splendid auroras are also recorded on June 11 and November 11, by Mr. Z. Thompson, of Burlington, Vt. On August 11, 1853, a slight aurora was visible at New Haven. On September 2, 1853, an aurora was seen at sea off Cape Race. On May 24, 1853, an aurora appeared at Perryville, in lat.  $37^{\circ}$  and long.  $39^{\circ}$ . Auroras were also seen there on April 22 and June 11, 1852. On April 5, 1853, a splendid aurora was witnessed at Burlington, Vt. On April 29, 1859, an auroral arch was seen at New Haven. But the last decade was redeemed from insignificance in respect to auroral displays by the prolonged and magnificent exhibition between August 28 and September 4, 1859, the geographical extent of which embraced the United States and Australia. Poey\* states that the aurora has been registered only six times at Cuba, viz., on November 13, 1784; on November 14, 1789; in November, 1833; on November 17, 1848; and on August 28 and September 1-2, 1859. Mr. Logan says that the aurora has been seen in California eleven times in 11 years, of which four were in 1860. The best displays were on August 28, 1859, and July 4, 1860. The late Professor Olmsted, in his valuable Smithsonian Contribution to Knowledge, "On the recent secular period of the Aurora Borealis," accepted for publication January, 1855, has attempted to approx-

\* American Journal of Science.

imate to a just estimate of the numerical value of this periodicity. I will state his conclusion in his own words.

“From the foregoing, and many similar inductions, I think it may be inferred, with considerable probability, that the greatest secular periods of the aurora borealis occur at intervals of about sixty-five years, reckoning from the middle of one period to the middle of another, although returns of a less remarkable character are probably interspersed among these.

“The *duration* of one of these great periods appears to be from 21 to 25 years. That which we have recently passed through commenced in 1827, and if we consider it as completed in 1848, when there was almost a cessation of the phenomenon in its higher forms for two years, its duration was 21 years. The occurrence of three exhibitions of the first class in September, 1851, and of one in February, 1852, throws some doubt on this point. Although the greatly diminished intensity since 1848 would incline me to consider the period as terminating then, yet these later exhibitions indicate a duration of 25 years. If we examine into the duration of other similar periods, we obtain corresponding results. Thus the return immediately preceding the recent one lasted from 1760 to 1783, a period of 23 years; and the next preceding that lasted from 1716 to 1740, another period of 24 years. On the whole, therefore, I conclude that the aurora borealis is subject to periodical returns, during which it is exhibited in extraordinary frequency and greatly augmented splendor and magnificence; that these periods are at intervals of about 65 years; that they last for a period not exceeding 25 years, and, consequently, that from the end of one visitation to the beginning of another is an interval of nearly 10 years, during which time the phenomenon is far less remarkable both in frequency and intensity.

“Probably similar periods occur in the polar regions, since travellers differ much in their account of the numbers and degrees of splendor of these exhibitions at different times.”\*

I propose to publish immediately, in a second memoir, a complete catalogue of auroras, and then to renew the discussion in regard to the periodicity of the phenomenon with more ample materials.

\* Pages 38, 39.

## CATALOGUE OF AURORAS.\*

*Compiled from Professor Winthrop's Journal.*

1742.		32	May 11.	Evening.	Aurora Borealis.
1	Dec. 29.	A small northern light this evening.	33	June 7.	(10 $\frac{1}{2}$ <sup>h</sup> , P. M.) Aurora Borealis.
2	" 30.	(11 <sup>h</sup> , P. M.) A faint appearance of the northern light.	34	Sept. 13.	Evening. Small Aurora Borealis.
1743.		35	Oct. 18.	At 9, P. M., a crimson Aurora Borealis.	
3	Jan. 23.	(11 <sup>h</sup> , P. M.) A considerable northern light.	36	Nov. 6.	Evening. Aurora Borealis.
4	Nov. 5.	A northern light in the evening.	37	" 9.	Evening. Small Aurora Borealis.
1744 - 5, None.		1750.			
1746.		38	Jan. 5.	Evening.	Small Aurora Borealis.
5	Mar. 12.	Evening. A considerable northern light.	39	" 6.	Aurora Borealis.
6	" 13.	(11 $\frac{3}{4}$ <sup>h</sup> , P. M.) Northern light.	40	Feb. 4.	(10 $\frac{3}{4}$ <sup>h</sup> , P. M.) Small Aurora Borealis.
7	" 29.	About midnight a northern light.	41	" 27.	Evening. Great Aurora Borealis.
8	June 12.	Evening. A considerable Aurora Borealis.	42	Mar. 4.	Aurora Borealis.
9	" 15.	Evening. Aurora Borealis.	43	" 11.	Evening. Small Aurora Borealis.
10	July 4.	Aurora Borealis from 11 $\frac{1}{2}$ <sup>h</sup> to 6 $\frac{1}{2}$ <sup>h</sup> .	44	April 8.	Evening. Small Aurora Borealis.
11	Dec. 14.	Evening. Small Aurora Borealis.	45	" 9.	Evening. Aurora Borealis.
1747.		46	" 14.	(7 $\frac{3}{4}$ <sup>h</sup> , P. M.) Considerable Aurora Borealis.	
12	Jan. 9.	Evening. Small Aurora Borealis.	47	" 30.	(After 8 $\frac{1}{2}$ <sup>h</sup> , P. M.) Aurora Borealis.
13	Feb. 6.	Evening. Aurora Borealis.	48	May 1.	Evening. Aurora Borealis.
14	" 7.	Evening. Aurora Borealis.	49	July 26.	Evening. Aurora Borealis.
15	May 29.	Evening. Small Aurora.	50	" 28.	Evening. Aurora Borealis.
16	July 5.	Morning. An Aurora Borealis.	51	Aug. 26.	Evening. Aurora Borealis.
17	Aug. 29.	Evening. A small Aurora Borealis.	52	Sept. 4.	Evening. Aurora Borealis.
18	" 30.	Morning. Great Aurora Borealis.	53	Nov. 2.	Evening. Bright Aurora Borealis.
19	Sept. 5.	Evening. Aurora Borealis.	54	" 4.	(6 $\frac{1}{4}$ <sup>h</sup> , P. M.) Aurora Borealis.
20	" 27.	Evening. Aurora Borealis.	1751.		
21	Dec. 26.	(10 <sup>h</sup> , P. M.) A small Aurora Borealis.	55	Feb. 12.	(8 <sup>h</sup> , P. M.) Aurora Borealis.
1748.		56	" 19.	Evening. Aurora Borealis.	
22	Feb. 3.	(10 $\frac{1}{4}$ <sup>h</sup> , P. M.) Aurora Borealis.	57	" 24.	Evening. Aurora Borealis.
23	April 7.	Evening. Aurora Borealis.	58	April 2.	Evening. Aurora Borealis.
24	Aug. 30.	Evening. Aurora Borealis.	59	June 27.	(11 $\frac{3}{4}$ <sup>h</sup> , P. M.) Aurora Borealis.
25	Nov. 1.	Evening. Aurora Borealis.	1752.		
26	Dec. 15.	Evening. Aurora Borealis.	60	Jan. 19.	Evening. Bright Aurora Borealis.
27	" 20.	Evening. Aurora Borealis.	61	Oct. 12.	(8 $\frac{1}{4}$ <sup>h</sup> , P. M.) Aurora Borealis.
1749.		1753.			
28	Feb. 16.	(10 <sup>h</sup> , P. M.) Small Aurora Borealis.	62	April 30.	(10 $\frac{1}{4}$ <sup>h</sup> , P. M.) Aurora Borealis.
29	March 9.	Evening. Aurora Borealis.	1754 - 6, None.		
30	April 5.	Evening. Aurora Borealis.	1757.		
31	" 18.	Evening. Small Aurora Borealis.	63	Aug. 13.	Evening. Aurora Borealis.
			64	Sept. 7.	Evening. Small Aurora Borealis.
			65	" 13.	Evening. Small Aurora Borealis.

\* All the dates are reduced to *new style*.

66 Sept. 14.	Evening.	Aurora Borealis.	105 June 3.	Evening.	Aurora Borealis.
67 Nov. 12.	Evening.	Great Aurora Borealis.	106 " 18.	(10 $\frac{1}{4}$ <sup>h</sup> , P. M.)	Remarkable Aurora Borealis.
68 " 13.	Evening.	Small Aurora Borealis.	107 " 19.	(10 $\frac{1}{4}$ <sup>h</sup> , P. M.)	Faint Aurora Borealis.
		1758.	108 July 27.	Evening.	Aurora Borealis.
69 Jan. 8.	Evening.	Bright Aurora Borealis.	109 Aug. 25.	Evening.	Aurora Borealis.
70 Mar. 12.	Evening.	Aurora Borealis.	110 Sept. 20.	At 8, P. M.,	an Aurora Borealis.
71 " 31.	Evening.	Very bright Aurora Borealis.	111 " 28.	Evening.	Aurora Borealis.
72 April 1.	Evening.	Small Aurora Borealis.	112 " 29.	(After 6 $\frac{3}{4}$ <sup>h</sup> , P. M.)	Aurora Borealis.
		1759.			1765.
73 Mar. 8.	Evening.	Bright Aurora Borealis.	113 Feb. 19.	Evening.	Aurora Borealis.
74 Sept. 9.	Evening.	Aurora Borealis.	114 July 21.	Evening.	Little Aurora Borealis.
75 " 11.	Evening.	Aurora Borealis.	115 " 22.	Evening.	Bright Aurora Borealis.
76 " 18.	(7 <sup>h</sup> , P. M.)	Small Aurora Borealis.	116 Aug. 17.	Evening.	Little Aurora Borealis.
77 Oct. 31.	Evening.	Very bright Aurora Borealis.	117 " 19.	Evening.	Bright Aurora Borealis.
		1760.	118 " 21.	Evening.	Little Aurora Borealis.
78 Mar. 14.	(10 <sup>h</sup> , P. M.)	Aurora Borealis.	119 Oct. 12.	Evening.	Aurora Borealis.
79 May 3.	(10 $\frac{1}{4}$ <sup>h</sup> , P. M.)	Bright Aurora Borealis.			1766, None.
80 Sept. 10.	Evening.	Aurora Borealis.			1767.
81 Oct. 4.	Evening.	Aurora Borealis.	120 July 18.	Evening.	Aurora Borealis.
82 " 25.	Evening.	Aurora Borealis.	121 " 28.	Evening.	Aurora Borealis.
83 Nov. 12.	(After 6 $\frac{3}{4}$ <sup>h</sup> , P. M.)	Aurora Borealis.	122 Aug. 18.	Evening.	Aurora Borealis.
		1761.			1768.
84 Mar. 10.	Evening.	Aurora Borealis.	123 Feb. 18.	Evening.	Aurora Borealis.
85 " 11.	Evening.	Aurora Borealis.	124 July 20.	Evening.	Remarkable Aurora Borealis.
86 Sept. 26.	(After 7 $\frac{1}{2}$ <sup>h</sup> , P. M.)	Aurora Borealis.	125 Aug. 6.	Remarkable Aurora Borealis,	like that of July 20.
87 Nov. 6.	Evening.	Aurora Borealis.	126 Sept. 14.	Evening.	Small Aurora Borealis.
88 " 19.	Evening.	Large Aurora Borealis.	127 Oct. 2.	Evening.	Aurora Borealis.
		1762.	128 Dec. 5.	Evening.	Very bright Aurora Borealis.
89 Feb. 4.	Evening.	Aurora Borealis.			1769.
90 May 21.	Evening.	Bright Aurora Borealis.	129 Jan. 5.	Evening.	Considerable Aurora Borealis.
91 Aug. 10.	Evening.	Bright Aurora Borealis.	130 Feb. 27.	Evening.	Bright Aurora Borealis.
92 " 11.	Evening.	Aurora Borealis.	131 June 9.	Evening.	Bright Aurora Borealis.
93 " 13.	(After 7 $\frac{3}{4}$ <sup>h</sup> , P. M.)	Aurora Borealis.	132 " 28.	Evening.	Small Aurora Borealis.
94 Sept. 15.	(After 7 $\frac{1}{2}$ <sup>h</sup> , P. M.)	Aurora Borealis.	133 " 29.	Evening.	Small Aurora Borealis.
95 Dec. 18.	Evening.	Bright Aurora Borealis.	134 July 2.	Evening.	Bright Aurora Borealis.
		1763.	135 " 7.	Evening.	Aurora Borealis.
96 April 24.	(10 $\frac{1}{2}$ <sup>h</sup> , P. M.)	Small Aurora Borealis.	136 " 8.	Evening.	Aurora Borealis.
97 May 2.	Evening.	Aurora Borealis.	137 Aug. 5.	Evening.	Aurora Borealis.
98 July 31.	Bright Aurora Borealis.		138 Sept. 26.	Evening.	Small Aurora Borealis.
99 Aug. 4.	Evening.	Aurora Borealis.	139 Oct. 7.	Evening.	Very bright Aurora Borealis.
100 Sept. 14.	Evening.	Bright Aurora Borealis.	140 " 28.	Evening.	Aurora Borealis.
101 Nov. 11.	Evening.	Bright Aurora Borealis.			
		1764.			
102 Feb. 16.	(10 $\frac{1}{2}$ <sup>h</sup> , P. M.)	Aurora Borealis.			
103 Mar. 5.	(10 $\frac{1}{4}$ <sup>h</sup> , P. M.)	Unusual Aurora Borealis.			
104 May 16.	Evening.	Aurora Borealis.			

- 141 Oct. 25. Evening. Small Aurora Borealis.  
 142 " 26. Evening. Small Aurora Borealis.  
 143 " 27. Evening. Aurora Borealis.  
 144 Dec. 6. Evening. Aurora Borealis.

## 1770.

- 145 Jan. 17. Evening. Aurora Borealis.  
 146 " 18. Evening. Aurora radiating in the East.  
 147 Feb. 28. Evening. Aurora Borealis.  
 148 Mar. 23. Evening. Aurora Borealis, and a glorious arch from East to West.  
 149 April 19. Evening. Great Aurora Borealis.  
 150 May 16. Evening. Small Aurora Borealis.  
 151 July 14. Evening. Aurora Borealis.  
 152 " 16. Evening. Aurora Borealis.  
 153 " 27. Evening. Small Aurora Borealis.  
 154 " 31. Evening. Aurora Borealis.  
 155 Aug. 27. Evening. Bright Aurora Borealis.  
 156 " 31. Evening. Aurora Borealis.  
 157 Sept. 9. Evening. Aurora Borealis.  
 158 " 10. Evening. Aurora Borealis.

## 1771.

- 159 Feb. 19. ( $10\frac{1}{4}$ h, P. M.) Aurora Borealis.  
 160 Mar. 17. Evening. Very bright Aurora Borealis.  
 161 " 18. Evening. Small Aurora Borealis.  
 162 June 2. Evening. Bright Aurora Borealis behind the clouds.  
 163 " 12. Evening. Little Aurora Borealis.  
 164 Aug. 16. Evening. Small Aurora Borealis.  
 165 " 17. Evening. Small Aurora Borealis.  
 166 Sept. 13. Evening. Small Aurora Borealis.  
 167 " 17. Evening. Aurora Borealis.  
 168 Oct. 4. Evening. Small Aurora.  
 169 " 18. Evening. Aurora Borealis.  
 170 Nov. 1. Evening. Aurora Borealis.  
 171 " 5. Evening. Aurora Borealis.  
 172 " 12. Evening. Small Aurora Borealis.  
 173 Dec. 4. Evening. Little Aurora Borealis.

## 1772.

- 174 Feb. 27. Evening. Aurora Borealis.  
 175 April 12. ( $10^h$ , P. M.) Small Aurora Borealis.  
 176 July 5. Evening. Aurora Borealis.  
 177 " 7. Evening. Aurora Borealis.  
 178 " 8. Evening. Great Aurora Borealis.  
 179 " 25. Evening. Remarkable Aurora Borealis.  
 180 Oct. 2. Evening. Aurora Borealis.

## 1773.

- 181 Jan. 17. Evening. Great Aurora Borealis.  
 182 " 19. Evening. Great streaming Aurora Borealis.  
 183 Mar. 15. Evening. Aurora Borealis.  
 184 " 23. Evening. Aurora Borealis.  
 185 May 19. Evening. Aurora Borealis.  
 186 June 6. Evening. Aurora Borealis.  
 187 " 10. Evening. Small Aurora Borealis.  
 188 " 13. Evening. Small Aurora Borealis.  
 189 " 14. Evening. Small Aurora Borealis.  
 190 " 24. Evening. Aurora Borealis.  
 191 July 12. Evening. Uncommon Aurora Borealis.  
 192 " 17. Evening. Great Aurora Borealis.  
 193 " 18. Evening. Small Aurora Borealis.  
 194 " 25. Evening. Aurora Borealis.  
 195 Aug. 15. Evening. Aurora Borealis.  
 196 " 25. Evening. Aurora Borealis in North-west.

## 1774.

- 197 Feb. 28. Evening. Aurora Borealis.  
 198 Mar. 13. Evening. Great Aurora Borealis.  
 199 April 3. Evening. Aurora Borealis.  
 200 June 4. Evening. Little Aurora Borealis.  
 201 July 9. Evening. Aurora Borealis.  
 202 " 12. Evening. Aurora Borealis.  
 203 " 13. Evening. Small Aurora Borealis.  
 204 " 28. Evening. Little Aurora Borealis.  
 205 " 29. Evening. Little Aurora Borealis.  
 206 Aug. 14. Evening. Great Aurora Borealis.  
 207 " 26. Evening. Aurora Borealis.  
 208 Sept. 1. Evening. Aurora Borealis.  
 209 " 10. Evening. Aurora Borealis.  
 210 Nov. 3. Evening. Aurora Borealis.  
 211 " 5. Evening. Aurora Borealis.

## 1775.

- 212 Jan. 29. Evening. Aurora Borealis.  
 213 Feb. 2. ( $11\frac{1}{4}$ h, P. M.) Little Aurora Borealis.  
 214 " 21. Evening. Aurora Borealis.  
 215 Mar. 25. ( $10\frac{1}{4}$ h, P. M.) Small Aurora Borealis.  
 216 July 18. Evening. Aurora Borealis.

## 1776.

- 217 April 18. Evening. Aurora Borealis.  
 218 Sept. 4. Evening. Aurora Borealis.  
 219 " 5. Evening. Aurora Borealis.  
 220 " 16. Evening. Aurora Borealis.

## 1777.

- 221 Jan. 28. Evening. Aurora Borealis.

222	Mar. 29.	Evening.	Aurora Borealis.	238	Mar. 17.	Evening.	Small Aurora Borealis.
223	April 6.	Evening.	Considerable Aurora Borealis.	239	" 22.	Evening.	Aurora Borealis.
224	" 11.	Evening.	Aurora Borealis.	240	" 24.	Evening.	Bright Aurora Borealis.
225	June 28.	Evening.	Aurora Borealis.	241	April 20.	Evening.	Small Aurora Borealis.
226	July 27.	Evening.	Little Aurora Borealis.	242	" 23.	Evening.	Bright Aurora Borealis.
227	Sept. 7.	Evening.	Great Aurora Borealis.	243	" 26.	Evening.	Aurora Borealis.
228	" 24.	Evening.	Aurora Borealis.	244	May 13.	Evening.	Aurora Borealis.
229	Oct. 8.	Evening.	Aurora Borealis.	245	June 14.	Evening.	Aurora Borealis.
230	Nov. 3.	Evening.	Great Aurora Borealis.	246	" 28.	Evening.	Aurora Borealis.
231	" 27.	Evening.	Extraordinary Aurora Borealis.	247	July 7.	Evening.	Uncommon Aurora Borealis.
232	" 28.	(12 $\frac{1}{4}$ h, A.M.) Evening.	Aurora Borealis continues.	248	" 31.	Evening.	Little Aurora Borealis.
233	Dec. 2.	Evening.	Aurora Borealis.	249	Sept. 22.	Evening.	Aurora Borealis.
234	" 21.	Evening.	Aurora Borealis.	250	" 24.	Evening.	Great Aurora Borealis.
1778.				1779.			
235	Jan. 18.	Evening.	Aurora Borealis.	251	Feb. 10.	Evening.	Bright Aurora.
236	Feb. 15.	Evening.	Aurora Borealis.	252	" 11.	Evening.	Aurora Borealis.
237	" 17.	Evening.	Bright Aurora Borealis.	253	" 13.	Evening.	Aurora Borealis.
				254	April 5.	Evening.	Aurora Borealis.

## C A T A L O G U E O F A U R O R A S .

*Compiled from Professor Wigglesworth's Journal.*

1780, defective.				271	April 2.	Aurora Borealis.
1781.				272	" 7.	Aurora Borealis.
255	Mar. 27.	Aurora Borealis.		273	" 27.	Aurora Borealis.
1782.				274	May 2.	Aurora Borealis.
256	Sept. 12.	Aurora Borealis.		275	" 13.	Aurora Borealis.
257	" 13.	Aurora Borealis.		276	" 29.	Aurora Borealis.
258	" 30.	Aurora Borealis.		1784.		
259	Oct. 2.	Aurora Borealis.		277	June 11.	Aurora Borealis.
260	" 3.	Aurora Borealis.		278	Sept. 15.	Aurora Borealis.
261	" 10.	Aurora Borealis.		279	Nov. 15.	Aurora Borealis.
262	Nov. 26.	Aurora Borealis.		280	Dec. 11.	Aurora Borealis.
1783.				1785.		
263	Jan. 31.	Aurora Borealis.		281	May 9.	Aurora Borealis.
264	Feb. 2.	Aurora Borealis.		282	Sept. 8.	Aurora Borealis.
265	" 27.	Aurora Borealis.		283	Oct. 6.	Aurora Borealis.
266	Mar. 2.	Aurora Borealis.		284	Nov. 29.	Aurora Borealis.
267	" 4.	Aurora Borealis.		285	" 30.	Aurora Borealis.
268	" 26.	Aurora Borealis.		286	Dec. 19.	Aurora Borealis.
269	" 29.	Aurora Borealis.		1786.		
270	" 30.	Aurora Borealis.		287	Feb. 28.	White Aurora Borealis.



288	Mar. 13.	(9 <sup>h</sup> , P. M.)	White Aurora Borealis.
289	" 19.		Bright Aurora Borealis at 8 o'clock.
290	" 22.		Aurora Borealis.
291	" 25.		Small Aurora Borealis.
292	" 27.		Aurora Borealis.
293	" 30.		Aurora Borealis.
294	" 31.		Aurora Borealis.
295	April 26.		Small Aurora Borealis.
296	" 28.		Small Aurora Borealis.
297	" 29.		Aurora Borealis.
298	May 31.		Aurora Borealis.
299	June 30.		Aurora Borealis.
300	July 1.		White Aurora Borealis.
301	" 2.		Aurora Borealis.
302	" 5.		Aurora Borealis.
303	" 15.		Aurora Borealis.
304	" 19.		Aurora Borealis.
305	" 27.		Aurora Borealis.
306	Aug. 22.		Aurora Borealis.
307	" 25.		Aurora Borealis.
308	Sept. 28.		Aurora Borealis.
309	" 29.		Aurora Borealis.
310	Oct. 13.		Aurora Borealis.
311	" 17.		Bright and red Aurora Borealis.
312	" 25.		Small Aurora Borealis.
313	Nov. 16.		Aurora Borealis.
314	" 21.		Aurora Borealis.

## 1787.

315	Jan. 17.		Aurora Borealis.
316	Feb. 15.		Aurora Borealis.
317	Mar. 20.		Aurora Borealis.
318	" 21.		Aurora Borealis.
319	April 14.		Aurora Borealis.
320	" 18.		Aurora Borealis.
321	May 15.		Aurora Borealis.
322	" 16.		Aurora Borealis.
323	June 9.		Aurora Borealis.
324	" 10.		Aurora Borealis.
325	" 14.		Aurora Borealis.
326	July 13.		Bright Aurora Borealis.
327	" 14.		Bright Aurora Borealis.
328	Aug. 1.		Aurora Borealis.
329	" 10.		Aurora Borealis.
330	" 19.		Aurora Borealis.
331	Sept. 6.		Aurora Borealis.
332	" 18.		Aurora Borealis.
333	Oct. 4.		Aurora Borealis.
334	" 5.		Aurora Borealis.
335	" 13.		Aurora Borealis.

336	Oct. 31.		Aurora Borealis.
337	Nov. 3.		Red Aurora Borealis.
338	" 4.		Aurora Borealis.
339	" 24.		Red Aurora Borealis.
340	Dec. 1.		Aurora Borealis.
341	" 9.		Aurora Borealis.

## 1788.

342	Jan. 14.		Aurora Borealis.
343	Feb. 5.		Aurora Borealis.
344	Mar. 27.		Aurora Borealis.
345	" 28.		Aurora Borealis.
346	April 1.		Aurora Borealis.
347	" 29.		Aurora Borealis.
348	May 29.		Aurora Borealis.
349	July 25.		Aurora Borealis.
350	" 30.		Red Aurora Borealis.
351	" 31.		Aurora Borealis.
352	Aug. 1.		Aurora Borealis.
353	" 23.		Aurora Borealis.
354	" 26.		Aurora Borealis.
355	" 27.		Aurora Borealis.
356	" 28.		Aurora Borealis.
357	Sept. 2.		Aurora Borealis.
358	" 3.		Aurora Borealis.
359	" 4.		Aurora Borealis.
360	" 10.		Aurora Borealis.
361	" 24.		Aurora Borealis.
362	" 25.		Aurora Borealis.
363	" 26.		Aurora Borealis.
364	Oct. 4.		Aurora Borealis.
365	" 5.		Aurora Borealis.
366	" 22.		Aurora Borealis.
367	" 30.		Aurora Borealis.

## 1789.

368	Feb. 15.		Aurora Borealis.
369	" 26.		Aurora Borealis.
370	Mar. 14.		Aurora Borealis.
371	" 26.		Aurora Borealis.
372	" 27.		Aurora Borealis.
373	April 17.		Aurora Borealis.
374	" 26.		Aurora Borealis.
375	" 27.		Aurora Borealis.
376	May 21.		Aurora Borealis.
377	" 22.		Aurora Borealis.
378	" 23.		Vivid Aurora Borealis.
379	" 24.		Aurora Borealis.
380	" 28.		Aurora Borealis.
381	July 25.		Aurora Borealis.

382 July 27. Aurora Borealis.  
 383 Aug. 18. Aurora Borealis.  
 384 " 24. Aurora Borealis.  
 385 Oct. 19. Aurora Borealis.  
 386 " 23. Aurora Borealis.  
 387 Nov. 14. Vivid and red Aurora Borealis.

388 Dec. 18. Aurora Borealis.

1790 - 1792, no observations were made.

1793.

389 Mar. 13. Aurora Borealis.

390 Sept. 4. Aurora Borealis.

## CATALOGUE OF AURORAS.

*Compiled from Dr. Holyoke's Journal.*

1786.

391 Feb. 16. Aurora Borealis.  
 392 " 28. Aurora Borealis.  
 393 Mar. 19. Aurora Borealis.  
 394 " 21 or 22. Aurora Borealis.  
 395 " 25. Aurora Borealis.  
 396 " 27. Aurora Borealis.  
 397 " 30. Aurora Borealis.  
 398 " 31. Aurora Borealis.  
 399 April 2. Aurora Borealis.  
 400 " 6. Aurora Borealis.  
 401 " 11. Aurora Borealis.  
 402 " 28. Aurora Borealis.  
 403 " 29. Aurora Borealis.  
 404 May 23. Aurora Borealis.  
 405 " 31. Aurora Borealis.  
 406 June 1. Aurora Borealis.  
 407 " 19. Aurora Borealis.  
 408 " 30. Aurora Borealis.  
 409 July 1. Aurora Borealis.  
 410 " 2. Aurora Borealis.  
 411 " 5. Aurora Borealis.  
 412 " 15. Aurora Borealis.  
 413 " 17. Aurora Borealis.  
 414 " 20. Aurora Borealis.  
 415 " 27. Small Aurora Borealis.  
 416 Aug. 3. Aurora Borealis.  
 417 " 22. Aurora Borealis.  
 418 " 25. Aurora Borealis.  
 419 " 31. Aurora Borealis.  
 420 Sept. 3. Aurora Borealis.  
 421 " 28. Aurora Borealis.  
 422 " 29. Aurora Borealis.  
 423 Oct. 13. Aurora Borealis.  
 424 " 17. Aurora Borealis.

425 Oct. 25. Small Aurora Borealis.

426 " 27. Aurora Borealis.

427 Nov. 15. Small Aurora Borealis.

428 " 18. Aurora Borealis.

429 " 21. Aurora Borealis.

430 Dec. 5. Aurora Borealis.

431 " 15. Aurora Borealis.

1787.

432 Jan. 16. Aurora Borealis.

433 Feb. 6. Aurora Borealis, low.

434 " 9. Aurora Borealis, small and low.

435 " 15. Aurora Borealis.

436 " 20. Aurora Borealis.

437 " 22. Small Aurora Borealis.

438 Mar. 20. Aurora Borealis.

439 " 23. Aurora Borealis.

440 April 14. Aurora Borealis.

441 " 18. Aurora Borealis.

442 " 19. Aurora Borealis.

443 May 16. Aurora Borealis.

444 " 17. Very small Aurora.

445 June 8. Large Aurora Borealis behind clouds.

446 " 9. Aurora Borealis.

447 July 4. Small Aurora Borealis.

448 " 13. Aurora Borealis.

449 " 14. Aurora Borealis: streamers.

450 " 18. Aurora Borealis.

451 " 23. Small Aurora Borealis.

452 Aug. 1. Aurora Borealis.

453 " 10. Aurora Borealis.

454 " 13. Small Aurora Borealis.

455 " 19. Aurora Borealis.

456 Sept. 6. Small Aurora Borealis.

457 " 18. Aurora Borealis.

458 Oct. 5. Aurora Borealis.  
 459 " 7. Small Aurora Borealis.  
 460 " 13. Bright Aurora Borealis.  
 461 Nov. 3. Aurora Borealis.  
 462 " 4. Red Aurora Borealis.  
 463 Dec. 8. Small Aurora.  
 464 " 9. Small Aurora.

1788.

465 Jan. 10. Small Aurora Borealis.  
 466 " 14. Small Aurora Borealis.  
 467 Feb. 5. Aurora Borealis.  
 468 July 2. Very small Aurora Borealis.  
 469 " 25. Small Aurora Borealis.  
 470 " 30. Notable Aurora Borealis.  
 471 " 31. Small Aurora Borealis.  
 472 Aug. 1. Aurora Borealis.  
 473 " 23. Aurora Borealis.  
 474 " 26. Aurora Borealis.  
 475 " 27. Aurora Borealis.  
 476 " 28. Aurora Borealis.  
 477 Sept. 2. Aurora Borealis.  
 478 " 3. Aurora Borealis.  
 479 " 4. Aurora Borealis.  
 480 " 5. Aurora Borealis.  
 481 " 25. Aurora Borealis.  
 482 " 26. Aurora Borealis.  
 483 " 28. Small Aurora Borealis.  
 484 Oct. 5. Small Aurora Borealis.  
 485 " 6. Small Aurora Borealis.  
 486 " 22. Aurora Borealis.  
 487 " 30. Small Aurora Borealis.

1789.

488 Feb. 16. Aurora Borealis.  
 489 " 26. Aurora Borealis.  
 490 Mar. 14. Bright Aurora Borealis.  
 491 " 26. Small Aurora Borealis.  
 492 " 27. Small Aurora Borealis.  
 493 " 29. Small Aurora Borealis.  
 494 April 26. Aurora Borealis.  
 495 " 27. Aurora Borealis.  
 496 May 20. Aurora Borealis.  
 497 " 21. Aurora Borealis.  
 498 " 22. Aurora Borealis.  
 499 " 23. Aurora Borealis.  
 500 " 24. Aurora Borealis.  
 501 " 28. Aurora Borealis.  
 502 June 15. Aurora Borealis.  
 503 " 17. Aurora Borealis.  
 504 " 19. Aurora Borealis.

505 June 20. Aurora Borealis.  
 506 " 23. Aurora Borealis.  
 507 " 29. Aurora Borealis.  
 508 July 11. Aurora Borealis.  
 509 " 20. Aurora Borealis.  
 510 " 26. Aurora Borealis.  
 511 " 28. Aurora Borealis.  
 512 " 29. Aurora Borealis.  
 513 Aug. 18. Bright Aurora Borealis.  
 514 " 24. Aurora Borealis.  
 515 Sept. 9. Aurora Borealis.  
 516 " 21. Aurora Borealis.  
 517 " 22. Aurora Borealis.  
 518 Oct. 16. Aurora Borealis.  
 519 " 19. Aurora Borealis.  
 520 " 21. Aurora Borealis.  
 521 " 23. Aurora Borealis.  
 522 Nov. 14. Aurora Borealis, beautifully variegated, and reaching to the zenith.  
 523 Dec. 13. Aurora Borealis.  
 524 " 14. Aurora Borealis.

1790.

525 Feb. 11. Aurora Borealis.  
 526 " 13. Aurora Borealis.  
 527 May 16. Aurora Borealis.  
 528 " 17. Aurora Borealis.  
 529 June 3. Aurora Borealis.  
 530 " 30. Aurora Borealis.  
 531 July 1. Aurora Borealis.  
 532 " 3. Aurora Borealis.  
 533 Aug. 16. Aurora Borealis.  
 534 Oct. 31. Aurora Borealis.  
 535 Nov. 10. Aurora Borealis.

1791.

536 Jan. 6. Aurora Borealis.  
 537 " 12. Aurora Borealis.  
 538 Mar. 22. Aurora Borealis.  
 539 " 26. Aurora Borealis.  
 540 April 1. Small Aurora Borealis.  
 541 " 5. Aurora Borealis.  
 542 July 22. Aurora Borealis.  
 543 " 23. Aurora Borealis.  
 544 " 24. Aurora Borealis.  
 545 " 28. Aurora Borealis.  
 546 Dec. 27. Aurora Borealis.

1792.

547 July 7. Aurora Borealis.  
 548 " 11. Aurora Borealis.

549	July 18.	Aurora Borealis.			1805.
550	Oct. 13.	Aurora Borealis.	571	Jan. 4.	(10 <sup>h</sup> , P. M.) Aurora Borealis.
551	" 14.	Aurora Borealis.	572	Sept. 15.	(10 <sup>h</sup> , P. M.) Aurora Borealis.
552	Dec. 15.	Aurora Borealis.	573	Nov. 18.	(10 <sup>h</sup> , P. M.) Aurora Borealis.
		1793.			1806.
553	Jan. 12.	Aurora Borealis.	574	April 13.	(10 <sup>h</sup> , P. M.) Aurora Borealis.
554	" 13.	Aurora Borealis.	575	Oct. 5.	(10 <sup>h</sup> , P. M.) Aurora Borealis.
555	Mar. 13.	Aurora Borealis.			1807, 1808, none.
556	Aug. 6.	Aurora Borealis.			1809.
557	" 28.	Aurora Borealis.	576	Jan. 31.	(10 <sup>h</sup> , P. M.) Aurora Borealis.
558	Sept. 2.	Aurora Borealis.	577	June 13.	(10 <sup>h</sup> , P. M.) Aurora Borealis.
		1794.			1810 - 1813, none.
559	April 30.	Aurora Borealis.			1814.
		1795.	578	Feb. 28.	Aurora Borealis.
560	May 24.	Aurora Borealis.	579	April 17.	(10 <sup>h</sup> , P. M.) Aurora Borealis.
561	Oct. 14.	Aurora Borealis.	580	Sept. 11.	(11 <sup>h</sup> , P. M.) Aurora Borealis.
		1796 - 1801, none.			1815.
		1802.	581	Sept. 26.	Aurora Borealis.
562	June 16.	Aurora Borealis.			1816, 1817, none.
		1803.			1818.
563	Mar. 19.	Aurora Borealis.	582	Sept. 27.	(10 <sup>h</sup> , P. M.) Aurora Borealis.
564	Aug. 23.	Evening. Aurora Borealis.			1819.
565	Sept. 17.	Evening. Aurora Borealis.	583	Feb. 19.	(10 <sup>h</sup> , P. M.) Aurora Borealis.
566	" 19.	Evening. Aurora Borealis.	584	Mar. 25.	(10 <sup>h</sup> , P. M.) Aurora Borealis.
		1804.	585	" 26.	(10 <sup>h</sup> , P. M.) Aurora Borealis.
567	April 1.	Evening. Aurora Borealis.	586	Nov. 13.	(10 <sup>h</sup> , P. M.) Aurora Borealis.
568	May 2.	Evening. Aurora Borealis.	587	" 14.	(10 <sup>h</sup> , P. M.) Aurora Borealis.
569	" 12.	Evening. Aurora Borealis.			1820.
570	Nov. 5.	Evening. Aurora Borealis.	588	April 3.	(10 <sup>h</sup> , P. M.) Aurora Borealis.

## C A T A L O G U E O F A U R O R A S .

*Compiled from Dr. Hale's Journal.*

		1818.			1821, none.
589	Sept. 26.	(12 <sup>h</sup> , P. M.) Aurora Borealis.			1822.
		1819.	595	Oct. 22.	Aurora Borealis.
590	Feb. 19.	Aurora Borealis.			1823, 1824, none.
591	Mar. 25.	Brilliant Aurora Borealis.			1825.
592	Oct. 12.	Aurora Borealis in evening.	596	April 14.	Aurora Borealis.
593	Nov. 13.	(10 <sup>h</sup> , P. M.) Aurora Borealis.	597	Dec. 7.	Aurora Borealis.
		1820.			1826, none.
594	April 3.	Aurora Borealis, night of 3 - 4.			

1827.			612	Sept. 16.	Aurora Borealis in evening.
598	Sept. 8.	Brilliant Aurora Borealis.	613	Nov. 12.	(10 <sup>h</sup> , P. M.) Aurora Borealis. From
599	" 25.	Aurora Borealis.			11 to 12 very bright.
1828, 1829, none.			614	" 14.	(9 <sup>h</sup> , P. M.) Aurora Borealis.
1830.			615	" 25.	Aurora Borealis.
600	June 10.	Aurora Borealis.	1839.		
601	" 11.	Aurora Borealis.	616	June 14.	(7 <sup>h</sup> , P. M.) Aurora Borealis. At 10,
602	Dec. 11.	Brilliant Aurora Borealis.			brilliant.
1831 - 1834, none.			617	" 19.	Evening. Aurora Borealis. From 9
1835.					to 10 bright.
603	Nov. 17.	Aurora Borealis.	618	Sept. 3.	Aurora Borealis.
604	" 18.	Aurora Borealis.	1840.		
1836.			619	May 29.	Aurora Borealis.
605	April 22.	Aurora Borealis.	620	Aug. 28.	(9 <sup>h</sup> to 12 <sup>h</sup> , P. M.) Aurora Borealis.
1837.					At 11, very bright.
606	July 1.	Aurora Borealis.	1841.		
607	Dec. 1.	Aurora Borealis.	621	Feb. 22.	(8 <sup>h</sup> to 9 <sup>h</sup> , P. M.) Aurora Borealis.
608	" 4.	Aurora Borealis in evening.	622	" 23.	(11 <sup>h</sup> , P. M.) Aurora Borealis.
1838.			1847.		
609	Feb. 21.	Brilliant Aurora Borealis. At 7, P.	623	April 7.	Aurora Borealis, from 10 <sup>h</sup> , P. M., to 3 <sup>h</sup> ,
		M., of a beautiful color; at 10, P.			A. M., next morning.
		M., of a pale color.	1848.		
610	July 15.	Aurora Borealis.	624	April 6.	(10 <sup>h</sup> to 11 <sup>h</sup> , P. M.) Brilliant Aurora
611	Sept. 13.	Aurora Borealis in evening.			Borealis.